DOCUMENT RESUME

ED 238 878 SP 023 652

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TITLE Schools and Computers: What to Do and What to Expect.
PUB DATE Jan 84
NOTE 19p.
PUB TYPE Reports - Descriptive (141)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Attendance; *Computer Oriented Programs; Computer Programs; *Curriculum Design; *Data Analysis; *Data Processing; Elementary Education; Inservice Teacher Education; Media Selection; *Program Development; Program Implementation; School Role; *Student Records
IDENTIFIERS *Kendall Demonstration Elementary School DC

ABSTRACT

The Kendall Demonstration Elementary School (KDES), a national demonstration school for the deaf in the District of Columbia and part of the Gallaudet College system, continuously updates its curriculum. In 1981, a needs assessment confirmed the need for computers in three areas: (1) administrative functions such as attendance, scheduling, and data analysis; (2) educational functions, such as maintaining a student database, monitoring student achievement, and generating individualized education plans; and (3) special support functions such as referral tracking, electronic mail, and word processing. Using these areas as a foundation, the school developed specifications which served as a guide for writing a request for a proposal that was submitted to various hardware and software developers and vendors for bids. KDES placed initial emphasis on the data management aspect of computers. The structure that KDES chose allowed the school to organize its curriculum into a miniumum of three levels and a maximum of six. KDES preparation of student data for entry into a computerized system required organization of information into a hierarchical structure. Once both data bases (curriculum data and student data) were entered into the computer, they were ready to serve as a tool for teachers, resource personnel, and administrators in their daily tasks. Instruction on how to use the system was specific to personnel needs. This paper also includes eight tables and more detailed information on computer implementation at KDES. (JMK)

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SCHOOLS AND COMPUTERS: WHAT TO DO AND WHAT TO EXPECT

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January, 1984

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SCHOOLS AND COMPUTERS: WHAT TO DO AND WHAT TO EXPECT

Repeatedly the cry from schools is, "I just bought some computers; now what do I do." Pressure to get involved with computers and/or a deal that is just too good to refuse has placed the school in the position of owning hardware with no appropriate software and no plan for the use of the computers. The school does not know where to start or what lies ahead. Literature related to the use and purchase of computers is flooding the market[1]. ASCD published Computers in Curriculum and Instruction(1983) which familiarizes schools with the basics. This article is intended to add to that body of information by discussing three major functions of computers in a school setting (administrative, instruction, and special support) and by giving an in depth description of how to computerize curriculum and student information. It represents knowledge gained through three years of work creating and implementing a computer managed educational system at Kendall Demonstration Elementary School (KDES)[2].

Assessing Needs

Like many other schools, KDES continuously updates its curriculum. Upon finishing the 1981 curriculum guides, a need was felt for computerized management of the student educational programs (student biographical and medical data, past educational history, progress in the different curriculum areas, etc.). In order to determine if there was indeed a valid need for such a system and if it could be integrated with the need to make computers a functional tool for our students, the school hired outside computer consultants to conduct a needs assessment that would determine whether or not a computer system was appropriate. The results confirmed the need for computers in three areas:

1. Administrative functions such as attendance, scheduling, and data analysis
2. Educational functions such as maintaining a student data-base, monitoring student achievement, generating IEPs
3. Special support functions such as referral tracking, electronic mail, and word processing

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1. For a good simple reference, see: Marcella R. Pitts, The Educator's Unauthorized Microcomputer Survival Manual. Washington, D.C.: Council for Educational Development and Research [1983].

2. KDES is a national demonstration school for the deaf and part of the Gallaudet College system. In fact, KDES was the precursor to Gallaudet College today.

Using these areas as a foundation, the school developed specifications which served as a guide for writing a request for proposal that was submitted to various hardware and software developers and vendors for bids. It is important to mention that schools that are looking for implementation of a computer system must have the specifications very clearly stated for bidders. At the same time, it is also important to make sure that bidding is focused on the software needs rather than on the hardware needs. The development of software is an expensive venture; if software can be found that is appropriate or that can be modified, the expenditure of money and manhours will be greatly reduced. Hardware should be the last thing to worry about. Any book on computers today will warn the reader concerning this matter.

Table 1 shows a summary of the requirements for the KDES computer system.

Table 1

Requirements for the KDES Computer System

1. The format of the current objectives can be easily entered without major revisions; i.e. the number of objectives should not have to be reduced and the length of the objective statement should not have to be shortened.
2. Making changes in objectives and other parts of the curriculum can be done at any time; thus, a constantly revised and updated curriculum is always possible (on line).
3. Teacher access to the stored objectives and activities should be easy, requiring no special programming knowledge.
4. Tracking of student progress is possible; i.e., a teacher can see/print a student record that lists objectives accomplished by the student in any curriculum area.
5. IEP's can be generated from the data in the student and curriculum data banks.
6. Administrative reports can be generated from the student and curriculum data banks.
7. The system and the curriculum data banks can be easily shared with other schools for the hearing-impaired across the nation.
8. The hardware and software is compatible with hardware currently used by schools and/or is inexpensive enough that the average program for the hearing-impaired can afford to purchase it.

Kendall decided to place initial emphasis upon the data management side of computers. Computer Aided Instruction (CAI) also received attention, but did not require the concentrated effort that was needed to set up curriculum and student data bases. It

could be handled in house without the need for aid from an outside contractor. This was reflected in its absence from the specifications. The plan for CAI is described in a later section of this paper.

Selecting the best bid to fit Kendall's needs and budget also identified the appropriate hardware and software for the school's system. In addition, it helped to determine the order of implementation of different parts of the program. Those sections for which there was already software on the market could be implemented first. In this case, the word processing component was first to be implemented. Since it required no special development effort, only training of appropriate personnel on how to use the commands, the word processing component will not be discussed.

Also already available for our system were the curriculum and student management systems[1]. Although modifications would be needed to meet the exact specifications of our system, work on entering the content of the educational program could be begun without jeopardizing the data entered. Student data, on the other hand, could not be entered until a "template" was developed to house that information. Therefore, while faculty and staff at the school were learning to use the word processing part of the system, other components of the total system were being entered, researched, planned, and developed.

Organizing Curriculum Content

Even though the curriculum data could be readily entered into the existing system, examination of the process of maximizing on a computerized system's capabilities revealed that the organization of data and the order in which data is entered can make a big difference in the ability to quickly retrieve/view the information. Many of the requirements for such systems are the same. This section describes the process used by Kendall School in organizing and entering the content of its program guides.

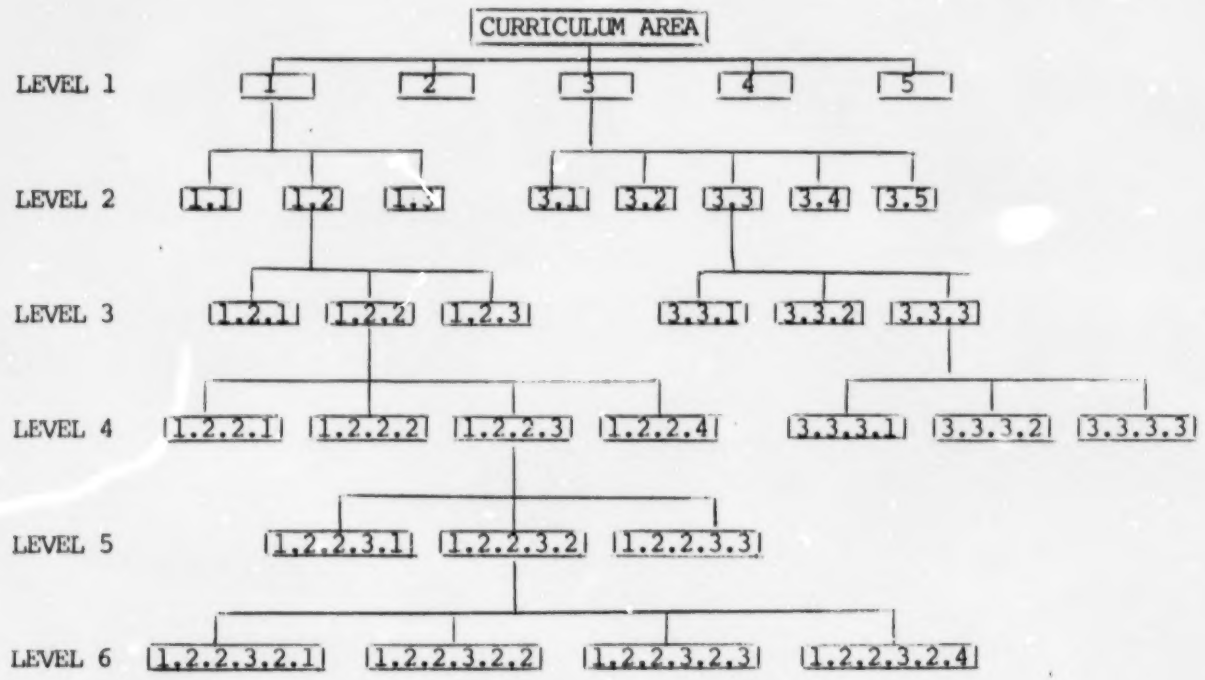
The usual method for organizing the content of an educational program is to state general goals for the program followed by a scope and sequence containing subgoals or objectives; i.e., it requires two levels of information (goals and objectives). The goals are usually broad statements that could be open to many interpretations; the objectives are more specific. In order to most efficiently use a computer's capabilities, the content of an educational program should be organized in a hierarchical, systematic approach containing multiple levels of information. Such an approach starts by dividing the content into broad categories and then subdividing

1. KDES contracted with Learning Tools, Inc., Cambridge, Massachusetts, to modify its "Super Planner" package and to create/locate the other components of the school's computer managed education system.

those categories several more times until the objective level is finally reached. Instead of stopping with the objective level, some schools may wish to include one more level of information. This level would provide ideas for teaching and testing the objective and might include such items as a list of vocabulary, some suggested activities, materials available to support instruction, and appropriate evaluation procedures.

The software that KDES chose allowed the school to organize its curriculum into a minimum of three (3) levels and a maximum of (6) levels. The number of levels that the reader should use will depend upon the software chosen and upon the content of the particular curriculum being computerized. Table 2 shows a schematic of the structure required to use the maximum number of levels. The table uses numbers to aide in the visualization of the subdivisions.

Table 2



Before giving an example from a curriculum guide to show the appliation of the system shown above, there are two other factors that need to be considered when dividing the content of an educational program into its various levels.

First, the number of items at each level and the length of the statements in each item may be restricted. In the format used by KDES both number and length were virtually unlimited (except by the ability of the storage device); i.e. it did not matter if Kendall's curriculum guides had 5 items at Level 1 or 25 items. It also did not matter if the items were two words or five sentences long. This allowed a flexibility that was not present in many systems examined and meant less modification of the guides.

The second consideration at this point which had not been anticipated was "screen size". To maximize on the movement from level to level it is desirable to have 9 to 15 items on the screen at each level (but not mandatory!). Table 3 shows an example of poor and good usage of a screen page.

Table 3

Poor Screen Use

```
 _____________________
| Item 1              |
| Item 2              |
| Item 3              |
|                     |
|                     |
|                     |
|                     |
|                     |
|                     |
|_____________________|
```

Good Screen Use

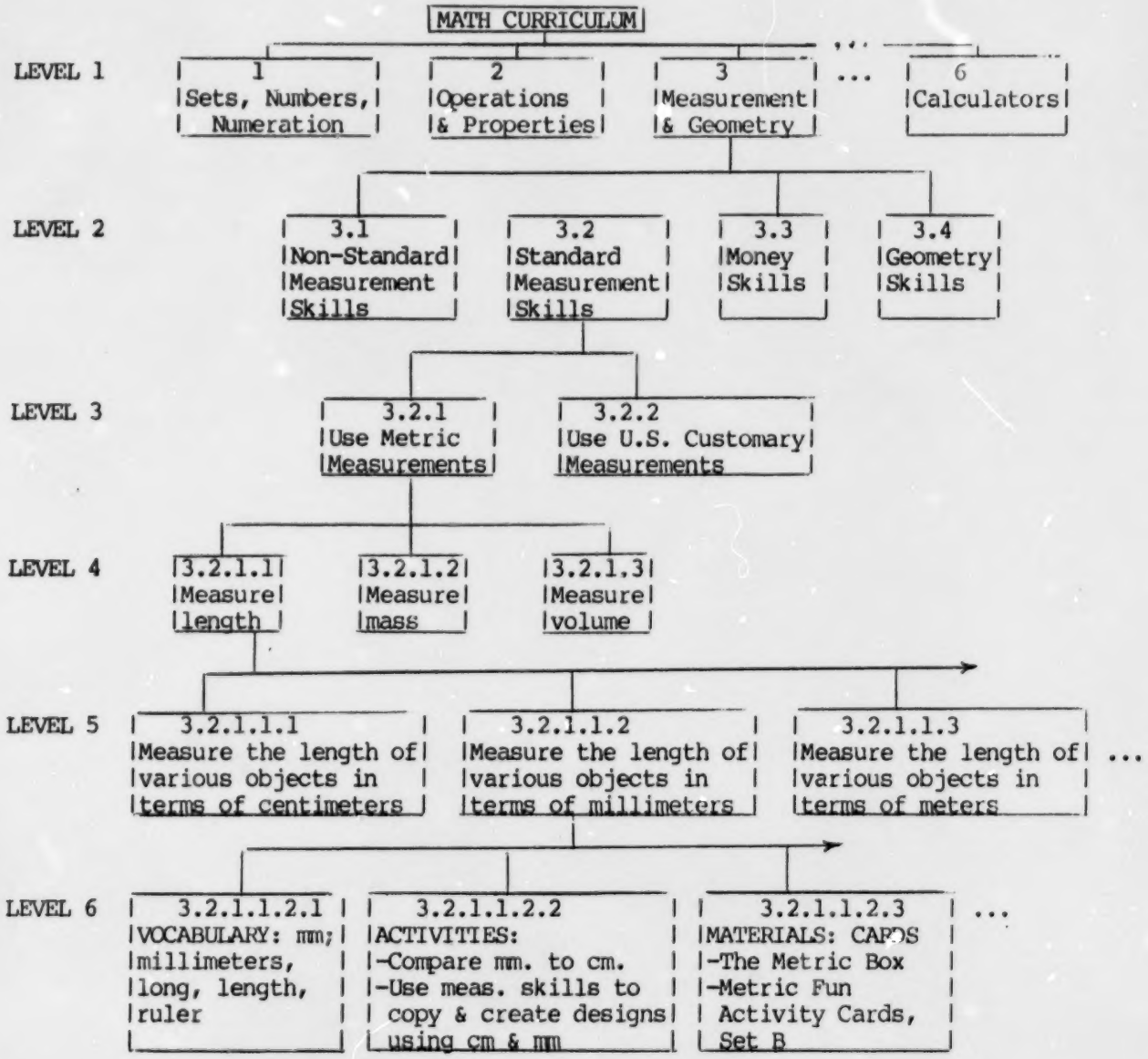
```
 _____________________
| Item 1              |
| Item 2              |
| Item 3              |
| Item 4              |
| Item 5              |
| Item 6              |
| Item 7              |
| Item 8              |
| Item 9              |
|_____________________|
```

Use of multiple screens like that on the first screen above means paging through several screen pages to find the appropriate Item. Use of the second screen above lets the user see more topics at a time and thus move through fewer pages to find the desired item. The result of this is less time spent searching for a desired Item.

Some of the curriculum guides already had an appropriate number of subdivisions to easily fit into this computerized format; some did not. Contrary to the common belief that mathematics will fit any computerized system, the mathematics guide, as it was previously developed, did not fit. It had 6 strands or items at Level 1; under each strand was a list of objectives. These objectives ranged from 9 objectives for the "Calculators" strand to 117 objectives for the "Operations and Properties" strand.

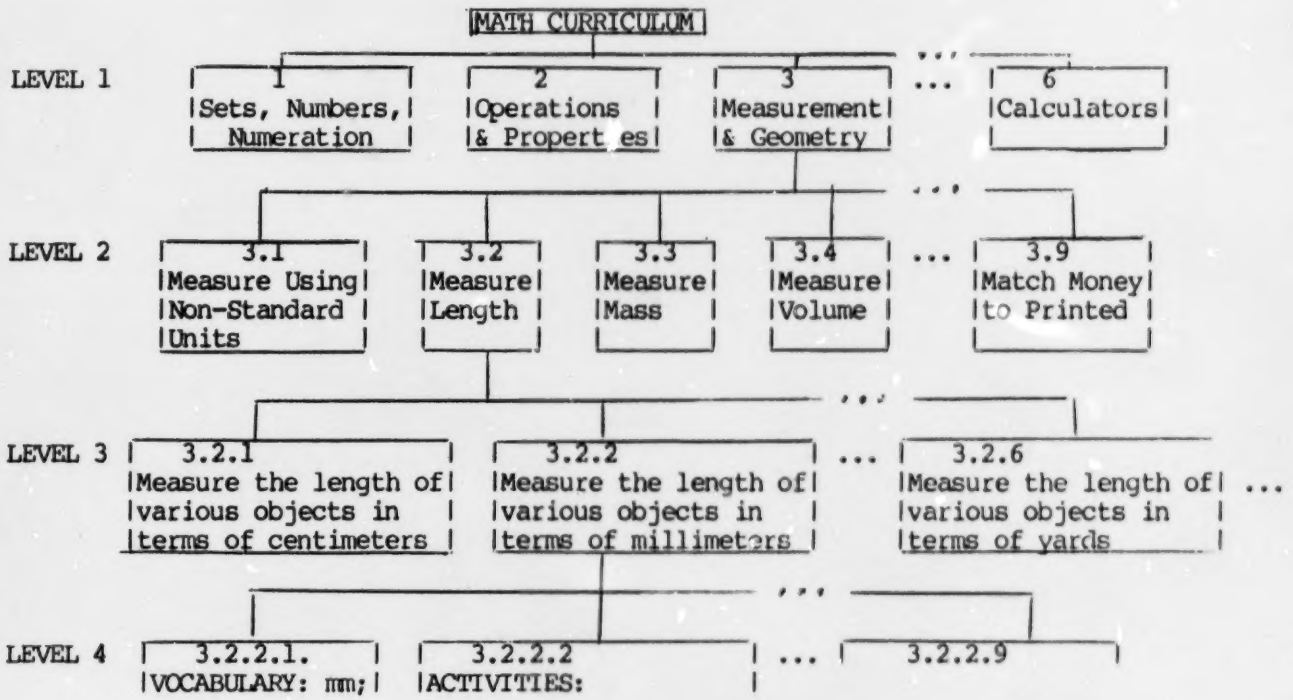
An attempt to place the mathematics curriculum guide into the format outlined in Table 2 above might look like Table 4 below:

Table 4


MATH CURRICULUM
LEVEL 1
1 Sets, Numbers, Numeration
2 Operations & Properties
3 Measurement & Geometry
...
6 Calculators
LEVEL 2
3.1 Non-Standard Measurement Skills
3.2 Standard Measurement Skills
3.3 Money Skills
3.4 Geometry Skills
LEVEL 3
3.2.1 Use Metric Measurements
3.2.2 Use U.S. Customary Measurements
LEVEL 4
3.2.1.1 Measure length
3.2.1.2 Measure mass
3.2.1.3 Measure volume
LEVEL 5
3.2.1.1.1 Measure the length of various objects in terms of centimeters
3.2.1.1.2 Measure the length of various objects in terms of millimeters
3.2.1.1.3 Measure the length of various objects in terms of meters
...
LEVEL 6
3.2.1.1.2.1 VOCABULARY: mm; millimeters, long, length, ruler
3.2.1.1.2.2 ACTIVITIES: -Compare mm. to cm. -Use meas. skills to copy & create designs using cm & mm
3.2.1.1.2.3 MATERIALS: CARDS -The Metric Box -Metric Fun Activity Cards, Set B
...

The length of the items in the example above are short and easy to follow; one would not have to scan more than one page at each level. This, so far, seems to indicate that the above divisions are appropriate. However, the criteria of 9 to 15 items per screen page would not be met. The user would be forced to do more searching than is necessary if the content were to be reorganized to take better advantage of the screen page. Table 5 below shows an example of how this particular part of the math curriculum might be reorganized to do that:

Table 5



Modifying the Style of Writing

In addition to the modifications in the general structure of the guides, it also became apparent that some modification was needed in writing style. Although efforts were made as the guides were developed for the printed copy to keep the writing styles as similar as possible, there were obvious differences that surfaced as a result of entering them into the computer. Some of these differences were due to the content and philosophy of the curriculum area; others were due to the number of writers involved in the total effort. Some examples of modifications that were made include:

(1) Changing the objective statement format so that all objectives began with a verb in the future tense with "The student will" as an understood but unwritten component.

(2) Listing all materials from the school's library under the appropriate objectives in a similar format.

Entering the Curriculum Information

Another aspect of creating a computerized curriculum is knowing how to enter the information so that it can be most rapidly accessed. In other words, will the way information is entered make a difference in the speed with which it will appear on the computer screen. Will it make a difference:

(1) if all of the items from Level 1 are typed in first, followed by all the items on Level 2, followed by all the items on Level 3, etc. In this method no item from Level 2 would be entered until all the items from Level 1 are entered; no items from Level 3 would be entered until all the items from Level 2 are entered; etc.

OR

(2) if an item from Level 1 and all the sublevels for that item are entered before moving on to the second item in Level 1. In this method the second item from Level 1 would not be entered until all the information under the first item on Level 1 had been entered.

Inquiries about the method of storing and retreiving data on the system used at KDES indicated that information would be more quickly displayed on a screen page by entering all higher level information first and working on lower level information only after all the higher level information was entered (i.e., the first method described above). Therefore, for the mathematics curriculum guide illustrated in Table 4, the Level 1 names (Sets, Numbers, Numeration; Operations and Properties; etc.) were entered first. Then, the Level 2 items (Measure Using Non-Standard Units; Measure Length; Measure Mass; etc.) were entered next for all of the Division items. Third, the Level 3 items (objectives) for each of the Level 2 items were entered. And, finally, the Level 4 items (vocabulary, activities, materials) were entered.

Revising and Updating the Computerized Material

If a curriculum is to be useful it must be capable of change. One benefit of computerization should be the ease with which both updates and revisions can be made. Not all software designed for organizing curricula permit easy modification of the data. The system used at KDES allows easy modification at any level. However, one word of caution: Making revisions and updates will change the numbering system in the curriculum; therefore, any tracking of student progress based on the numbers in the original numbering system would become invalid after the changes.

Once the curriculum has been entered into the computer, proofed, and corrected, two

copies of the information should be maintained:

(1) a fairly static or "working" copy that will reflect only updates and revisions that do not change the basic numbering structure necessary for maintaining records on student progress (e.g., changes in the mathematics curriculum used as an example above should be made only by: (a) adding goals or objectives if they fall at the end of any list of goals or objectives; or (b) by adding new vocabulary, materials, or activities); and

(2) a constantly changing copy that can be manipulated to reflect changes for the next comprehensive revision of the curriculum. This second copy would be the place to make major additions (e.g., evaluation strategies for each objective that might be developed at a later date).

Organizing Student Data

Preparing student data for entry into a computerized system also requires organizing the information into different levels. However, most systems either (1) provide a template into which data is plugged[1]; or (2) require the creation of a template. The latter provides for a more individualized format that can meet the needs of a particular school system since it permits the school to organize student information into categories the school chooses. In addition, some systems recognize only one kind of data entry (a specific number of spaces in which any kind of information may be typed) while others differentiate between the kind of data stored in a particular item (text, phone number, date, social security number, etc.). The latter type becomes more important when manipulation of the data is done to produce reports.

The system used by Kendall required the creation of a student template. The software for this, like the software for the curriculum data, required the organization of information into a hierachical structure, this time, with three levels: a "Section Title", a "Subsection Title", a "Data Item Title". The number of sections, subsections and data items was, like the number of levels in the curriculum software, limited only by the total amount of space on the storage device (floppy or hard disk). The data item could be either a text item (allowing up to 30 characters), a date, a phone number, a menu (listing up to 15 items from which one is chosen), an extended text item, a cash value, a number, a yes/no item, an age, or a social security item. In addition, each data item had two codes: (1) to indicate in which of 8 possible reports

1. A "template" is an outline or skeleton containing the cataegories of data which must be filled in for each student. It serves as a guide to inputting or reviewing information. The exact information for each data item will be different for each student (e.g. some will be male; some female) but the type of data required (e.g. sex) will be the same.

it should appear; and (2) to indicate which type of signon had access to the item[2]. Table 6 shows a schematic of the structure used for storage of student data.

Table 6

SCHEMATIC OF STUDENT MANAGEMENT SYSTEM

	Access	Report
Section Title	[ ]	[ ]
Subsection Title	[ ]	[ ]
Data Item Title	[ ]	[ ]
Data Item Title	[ ]	[ ]
Data Item Title	[ ]	[ ]
Subsection Title	[ ]	[ ]
Data Item Title	[ ]	[ ]
Data Item Title	[ ]	[ ]
Data Item Title	[ ]	[ ]
Data Item Title	[ ]	[ ]
Data Item Title	[ ]	[ ]
Subsection Title	[ ]	[ ]
Data Item Title	[ ]	[ ]
...	[ ]	[ ]
Section Title	[ ]	[ ]
Subsection Title	[ ]	[ ]
etc.	etc.	etc.

The first step in organizing the data was collecting all the information that would be needed. This involved collecting forms currently used to record information on students and then interviewing the persons who would be using the system when it was established. This activity revealed that many persons in the school were collecting the same pieces of information about a given student and were often not satisfied with the current forms being used. If the forms were inadequate, additional questions were asked to determine what data was not needed or what additional data was needed.

The second step in organizing the data was compiling the information; i.e., listing all data items that need to be included, eliminating duplications of information, and grouping the data items into meaningful groups or sections and subsections. Although using the management system to experiment with the organization of the data is tempting, this process of organization is most efficiently done by writing the data items on cards or pieces of paper which can by physically moved from group to group. A large bulletin board, a wall, or the floor serves well as a working space. When the

1. A total of 8 different levels of signon can be created in order to protect confidentiality of information. Individual signons have passwords that can be changed by the user to further protect data.

initial organization has been laid out, it should be shared with those persons who will be using it to verify that the organization is meaningful and complete. Table 7 shows the sections developed in Kendall's template; Table 8 shows the subsections of two sections; and Table 9 shows the data level of two subsections.

Table 7

SECTIONS PAGE FROM KDES STUDENT TEMPLATE

Kendall Demonstration Elementary School

Emergency Information
Family Information
Medical Information
Educational History
Class Placement/Schedule
Current Goals and Objectives
Referrals -- History
Referrals -- Current
Testing -- Achievement
Testing -- IQ
Testing -- Non-IQ

Table 8

TWO SUBSECTIONS PAGES FROM KDES STUDENT TEMPLATE

Emergency Information

Individual Information
Family Phone Numbers
Medical Contacts/Restrictions
Transportation Information

Referrals -- History

Psychological Assessment
Social-Emotional Assessment
Medical/Neurological Assessment
Perceptual-Motor Assessment
Audiological Assessment
Communication Assessment
Educational Assessment
Other Assessment Services

Table 9

ONE DATA SCREEN PAGE FROM KDES STUDENT TEMPLATE

Individual Information

First Name: (text data item)
Middle Name: (text data item)
Last Name: (text data item)
Nickname/Preferred Name: (text data item)
Sex: (menu: Male, Female)
Date of Birth: (age data item)
Current Age: (automatically computed item)

Ethnic Background: (menu: Black, White, American Indian, etc.)
Religious Preference: (menu: Catholic, Protestant, None, etc.)

Address -- Street: (text data item)
Address -- City: (text data item)
Address -- State: (text data item)
Address -- Zip Code: (number)

Step three is entering the template into the computer. Although entering the information would seem to indicate that the organization process is complete, it is not. If the previous organizing activities were well done, little re-organization will be needed. As in the entering of curriculum content, the screen page is important; i.e., the number of items in a section, subsection, or data item should be kept to 9-15 items so that the user does not need to page through more that one or two screen pages at each level. Examination of the system Kendall used indicated once again that search time for a user was increased if all the sections were entered first, all the subsections second, and all the data items last. As the data items were entered decisions could be made about the reports and access level desired. These decisions may also be postponed until a later date if they have not been established yet. One nice feature about the system used here was that the template could be modified even after specific student data had been entered without destroying the data previously entered. The managing system maintains a list of changes made to the template (e.g., inserting a new item or deleting an old one) and makes the modifications to the student template when the student data is viewed.

The final step in organizing the data is trying the template with sample student data. Several persons should try the process and make comments/recommendations for changes in the template.

Using the Curriculum and Student Data

Once both data bases (curriculum data and student data) have been entered into the computer, they are ready to serve as a tool for teachers, resource personnel, and administrators in their daily tasks. Instruction on how to use the system is very important. The instruction should be specific to the needs of the personnel.

For teachers the data base can aid in planning individual and class educational programs by:

1. identifying the current level of achievement for each student; and
2. identifying appropriate learning objectives, instructional strategies and materials to move that student to a higher level of achievement.
3. identifying students in the class with special educational, medical, or social needs.

Therefore, teacher training should focus on familiarization with viewing both curriculum content and student data. In addition it should provide instruction on how to enter and modify data in the student files, as well as how to produce reports.

For the resource personnel, the data base can aid in providing appropriate services to students by:

1. identifying students flagged for special service
2. tracking students receiving special service
3. writing regular reports on services provided

Instruction for resource personnel should be similar to that for teachers. If there is a curriculum for the resource personnel's area, the instruction should be identical.

For the administrator, the data base can aid in gathering summative information on the total student population.

All of the above functions can be accomplished in two ways: (1) manually (i.e., paging through the stored data to find information needed); or (2) automatically (i.e., asking the computer to search for and report out the information needed). The nature of the software into which the data bases have been plugged, the presence of a data base manager to manipulate the data, and the storage capability of the hardware determine which of the two ways is possible/most efficient. The system used by Kendall provided several reporting possiblities:

1. Direct viewing or printing of a curriculum content area or of an individual student's data were possible.
2. Up to 8 standardized reports (e.g. intake reports, IEP reports) could be printed out on an individual student based on a preselected set of items. These reports and the items included in the report were specified as the student data template was created.
3. Personally designed reports using information from the student data base can be created using an "administrative management system". These reports can report desired information on an individual students or can search all students and produce cumulative reports on students.

The administrator needs little or no instruction on the entering and modification of data; rather, instruction should focus on producing standard and specially designed reports.

If many types of hardware can run the software used by a program, opportunites should also be provided for users to learn as many types as they wish or need. The software used by Kendall permitted several hardware options. Data could be entered or viewed at

an Apple or IBM PC using floppy diskettes; it could be entered or viewed at an Apple or IBM PC connected to a Corvus Hard Disk; or it could be entered or viewed on an Apple or IBM PC networked via Corvus Omninet to a Corvus Hard Disk. Any information generated on one of the hardware configurations could be used on the other system (Apple diskettes could not be placed in IBM PC machines, but the data file could be transferred via the networking system to an IBM diskette). The speed of access to the data and the amount of data that could be processed was increased by using the IBM PC with 256 K or by using the Corvus Hard Disk.

Computer Assisted Instruction

As mentioned earlier, Computer Assisted Instruction did not require as much effort to implement. One factor in choosing software and hardware was the desire to be able to use the same type micros for both; however, it was not the most important factor. Luckily, the management system chosen ran on Apple computers; a large majority of the educational software available runs on Apple; most of the programs for the hearing impaired in the United States were using or planning to purchase Apples.

The plan for purchase of software was simple:

1. Resource teachers at the school in the areas of language arts, mathematics, science, and social studies would search catalogs and professional journals for software that seemed appropriate for their areas.

2. Software identified would be previewed before purchase (either at a local computer store or on "preview" from the distributing company).

3. Software recommended for purchase after the previewing would be purchased.

4. Purchased software would be listed in the computerized curriculum guides under appropriate objectives so that teachers would be aware of the software as they searched the curriculum for instructional ideas.

5. The software would be evaluated by teachers as they use it with their students. Additional copies of software will be purchased if teachers find it useful and in great demand.

Summary

Entering an educational program into a computer can facilitate planning and reporting on student progress at many different levels (classroom, support services,

administration). The quality of the software into which the educational data is entered; the organization of the data to be entered, and the hardware which runs the software all play an important part. Persons given the responsibility of making decisions for computerization are encouraged to:

1. Assess the needs of the school before buying. Is the problem large enough to warrant expenditures for a computer system?

2. Look for software that can do the job. Is there anything commercially available that is adequate?

3. Develop a comprehensive plan for computer ipmlementation based on the school's needs and the availability of software.

3. Organize curriculum content data and student data using paper and pencil before entering it into the computer. Is it in a meaningful, efficient, easy-to-use format?

In addition to the components of a computerized managed system listed above, a school may want to consider computerizing other aspects of their educational program. One area currently being investigated by Kendall is tests that can be used to evaluate different aspects of student performance (academic and non-academic). Since that effort is still in its beginning stages, it is not reported here; however, it, too, will require needs assessment and careful planning.

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